SAND MOUNTAIN - LAKE GUNTERSVILLE

WATER QUALITY PLAN

DECEMBER 1986

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Prepared by

SAND MOUNTAIN-GUNTERSVILLE LAKE WATER QUALITY COMMITTEE

Composed of

DeKalb County Soil and Water Conservation District
Etowah County Soil and Water Conservation District
Jackson County Soil and Water Conservation District
Marshall County Soil and Water Conservation District

With Assistance From

Soil Conservation Service
Tennessee Valley Authority
Farmers Home Administration
Geological Survey of Alabama
Environmental Protection Agency
Alabama Department of Public Health
Alabama Cooperative Extension Service
Alabama Agricultural Experiment Station
Alabama Department of Environmental Management
Top of Alabama Regional Council of Governments
Agricultural Stabilization and Conservation Service
DeKalb, Jackson, & Marshall County Health Departments

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PREFACE

Water quality problems in the Sand Mountain-Lake Guntersville Watershed were first noted in the State Agricultural Runoff Management Plan prepared in 1979. This plan, which was primarily an inventory of existing or potential non-point source pollution problems related to agriculture, identified Town Creek in DeKalb County as having severe water quality problems. The 1981 supplement to the plan identified Town Creek as one of the most critical watersheds having potential for polluting major waterbodies.

The Sand Mountain-Lake Guntersville watershed consisting of Town, Short, Scarham, and South Sauty Creeks was designated in September 1985 by the Alabama 208 Agricultural Task Force as the top priority watershed in the state having potential for non-point source pollution. The Task Force, made up of representatives from federal and state agencies and organizations concerned with agricultural pollution, offered assistance in developing a water improvement plan for the watershed.

This document is the product of over a year's work by a work group representing interested agencies. It identifies pollution problems, recommends abatement practices, and outlines a strategy to improve the water quality in the Sand Mountain-Lake Guntersville watershed. It provides a basis for decision-making at the local level and proposes a series of actions by a number of cooperating agencies to assist in cleaning up the surface and ground waters in the watershed.

Supplements to the water quality plan are being developed to present pertinent data and general information about the project area and to address specific recommendations of the plan. Supplement I describes the area in terms of its physiographic and geologic setting, land use, driving economies, population trends, and status of sewage treatment. Supplement II details a data collection and monitoring (DCM) plan to collect additional data that will better define sources of surface and ground water pollutants in the watershed. Additional documents will be developed as needed to guide implementation.

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SUMMARY

Water pollution is a serious and growing problem in the Sand Mountain-Lake Guntersville Watershed. A large portion of Lake Guntersville, the streams of the watershed, and the area's ground water are being contaminated by both agricultural and non-agricultural sources. The principal pollutants are nutrients, bacteria, and sediment. Other pollutants include dead animals and household garbage, runoff from urban areas, and contamination from dumping in abandoned wells.

Recent Tennessee Valley Authority (TVA) studies reveal that Town Creek, the largest stream in the project area, is contributing 10 percent of the total nutrient load to Guntersville Lake, while contributing less than one-tenth of one percent (0.1%) of the total inflow. Potential sources of this high level of nutrients include livestock and poultry wastes, runoff from cropland, and malfunctioning septic tank systems.

Sediment from the project area is creating large areas of shallow water along the margin of the lake. The rapid growth of aquatic plants in these areas presents problems for boating, skiing, swimming, and fishing activities and is detracting from the scenic beauty of the area. The principal source of sediment pollution is 65,000 acres of severely eroding cropland.

Bacterial pollution threatens both surface and ground water. Concentrations of fecal coliform bacteria in surface waters are not high at all times and in all locations; rather the high concentrations are often associated with runoff-producing storms or with a specific source, such as an overflowing waste lagoon.

Complaints filed with Alabama's Department of Environmental Management (ADEM) on surface water problems are more numerous in this watershed than in any other in the state, and they are increasing each year.

Ground water is almost routinely polluted. Local health officials have noted a serious decline in the purity of well water samples analyzed for rural households. They estimate that 75 percent of the samples now analyzed contain bacteria. The concentrations of bacteria occurring in both surface and ground waters are high enough to pose a severe threat to public health.

Sources of both bacterial and nutrient pollution include malfunctioning septic tank systems, discharges from pleasure boats on the lake, and livestock and poultry wastes. The probability is strong that a high percentage of the estimated 10,000 septic tank systems in the watershed are malfunctioning. Ninety percent of the soils of the area are rated as severely limited for septic tank systems. In addition the concentrations of hogs and poultry in this watershed are among the highest in the state. At any time about 15,000 hogs and 9 million chickens of all types are on hand. Each year these animals produce about 290,000 tons of wastes containing 3,500 tons of N, 1,800 tons of P_2O_5, and 1,900 tons of K_2O. The limited land available for spreading waste in the vicinity of these high-density production facilities complicates the problem of disposal.

Two state parks, Lake Guntersville and Bucks Pocket, are located within the project area. Their scenic beauty and unique setting attract thousands of

visitors each year. Complaints of odors and household wastes in the streams are being voiced by campers and other guests. Any further pollution of waters in the vicinity of these parks could have a serious impact on the $27 million annual tourism and recreation industry.

The Sand Mountain-Lake Guntersville Watershed was designated by Alabama's 208 Agricultural Task Force as the watershed having the greatest potential for non-point source pollution in the state. The DeKalb, Jackson, and Marshall County Soil and Water Conservation Districts formed a joint Water Quality Committee in 1985 to address the problems of water quality in the three counties and their impact on Lake Guntersville.

This plan was prepared in response to a request for assistance from the Sand Mountain-Lake Guntersville Water Quality Committee. It identifies the major water quality problems, their severity, and their possible sources. Actions are recommended for improvement, and a strategy is outlined to utilize the assistance of organizations, agencies, and groups both within and outside the project area. Agricultural pollution can be addressed through acceleration of existing programs and special projects such as USDA's Small Watershed Program. New initiatives by local governments with federal and/or state financial assistance will be required to control non-agricultural pollution. Additional data collection is needed to pinpoint high priority areas and to monitor improvement of water quality.

INTRODUCTION

BACKGROUND

This plan is prepared in response to a request for assistance from the Sand Mountain-Lake Guntersville Water Quality Committee which recognized a significant trend toward increased water pollution in their area. This Committee is composed of Soil and Water Conservation District (SWCD) Supervisors in DeKalb, Jackson, and Marshall Counties. In June 1985, they petitioned the State Soil and Water Conservation Committee to assist them in developing a water quality improvement plan for their area. This request was brought to the attention of the State's 208 Agricultural Task Force that developed the Agricultural Runoff Management Plan for Alabama.

In September 1985, the 208 Agricultural Task Force designated the Sand Mountain-Lake Guntersville Watershed as the top priority watershed in the state from the standpoint of its potential for non-point source pollution. The Task Force agreed to provide assistance in developing a plan to attack the area's water quality problems. A work group of federal, state, and local agencies was formed to develop a plan. Technical coordination of the work group has been provided by the USDA-Soil Conservation Service. The findings and recommendations of the work group are presented herein.

Water quality problems arising from both point and non-point sources have been noticeable on Sand Mountain for many years. Water samples from rural wells submitted to the Local Health Departments for analysis have indicated a serious

decline in ground water quality. One health official stated that "10 years ago, about 25 percent of all samples contained bacteria. Today, 75 percent contain bacteria". Complaints from Sand Mountain filed with Alabama's Department of Environmental Management (ADEM) are more numerous than from any other area of the state and are increasing each year. Fishermen, boating enthusiasts, campers, and businesses associated with recreation and tourism in the Lake Guntersville area have noted significant changes in the embayments that receive drainage from Sand Mountain. Sediment has created large areas of shallow water. Excessive plant growth in these areas has destroyed prime fishing areas and made them unsafe for boating activities. Campers and other guests in the two state parks located in the project area have complained of odors and visible pollutants in the streams.

Several agencies are conducting studies within this general area. These on-going studies and those previously made confirm that water quality problems and adverse impacts on the uses of water do exist. Results from these studies will be used in preparing future implementation plans.

PLAN DEVELOPMENT

Emphasis throughout this plan's development was on using existing information from a variety of sources. Input from area citizens and local government officials concerning the condition of water quality in the project area was obtained during four public meetings held early in the planning stage. Resource inventories, data files, annual reports, and information obtained through personal

interviews contributed to the data available for planning. Further data collection and water quality monitoring will be essential to fully define the problems.

This plan identifies the major water quality problems within the watershed and focuses attention on the various water uses that are impaired. The probable sources of the major contaminants have been identified, and actions are recommended to bring about improvements in water quality. Avenues of assistance (programs) are outlined, and a strategy is proposed for the cooperation of local, state, and federal agencies with leadership from local government to solve the problems.

This plan will serve as a guide for early actions such as data collection, monitoring, and detailed planning, and it will provide information for grant program applications. It will be used to inform and solicit support of local citizens, landowners, government officials, and civic and business organizations for improving the area's water quality. This basic plan will serve as a nucleus for subsequent plans to solve specific problems.

AREA SETTING

The Sand Mountain-Lake Guntersville Water Quality project area is located in the Tennessee River Basin and comprises about 400,800 acres in parts of DeKalb, Etowah, Jackson, and Marshall Counties. Major streams within the project area in the order of size are Town Creek, South Sauty Creek, Short Creek, and Scarham Creek (Figure 1.).

Although the area is predominately rural, and it is centered in the most densely populated rural area of the state, several large industrial and urban centers, notably Birmingham, Gadsden, Huntsville (AL), and Chattanooga (TN) are within commuting distance. Located in the heart of Alabama's "Mountain Lake Country," area residents have an abundance of water-based recreation and scenic beauty almost at their doorstep. Guntersville Lake is the major source of water-based recreation in this part of the state. An estimated 7.5 million visitor-days of recreational use per year creates a $27 million annual business for this area. Lake Guntersville and Buck's Pocket State Parks are located in the project area. Their facilities and outstanding recreation areas attract thousands of visitors each year.

Farms in the project area are small, and livestock and poultry are often the primary enterprises. DeKalb County is the Number 1 hog producer in the state, and DeKalb and Marshall Counties are the Number 2 and 3 counties respectively in poultry production.

Almost one-third of the project area is cropland. The clean-tilled cultivation of corn, soybeans, and Irish potatoes on the rolling to steep soils is conducive to excess erosion. Current erosion rates for soils in cultivation average about 10 tons per acre per year but on many fields erosion rates are as high as 40 tons per acre per year. The allowable erosion rate on most soils in the area is 2 to 3 tons per acre per year. About 25 percent of the cropland is adequately protected from erosion.

DeKalb, Jackson, and Marshall Counties had a combined population of 173,900 in 1980 and are projected to grow by 35 percent by 2000. Within the project area an estimated 10,700 septic tank systems are in operation. This number will increase to nearly 15,000 by the turn of the century if present trends continue. Considerable problems are occurring where septic tank systems are concentrated in the many rural communities throughout the area. At least 90 percent of all the soils in the project area have been classified as "severely limited" for septic tank and field line operation because the depth of most soils is less than four feet to parent rock.

In a broad sense, the economics of the project area are in conflict. Excessive sediment, nutrients, and bacteria from agriculture are affecting other segments of the area's economy and well being. The thousands of homeowners that reside in the rural area and enjoy "country living" are creating domestic waste problems that are becoming more acute each year. The area's recreation and tourism industry and a significant commercial fishery are being affected by the pollutants which discharge to the streams and finally enter Lake Guntersville.

Additional information about the project area can be found in SUPPLEMENT 1, DESCRIPTION OF THE AREA.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

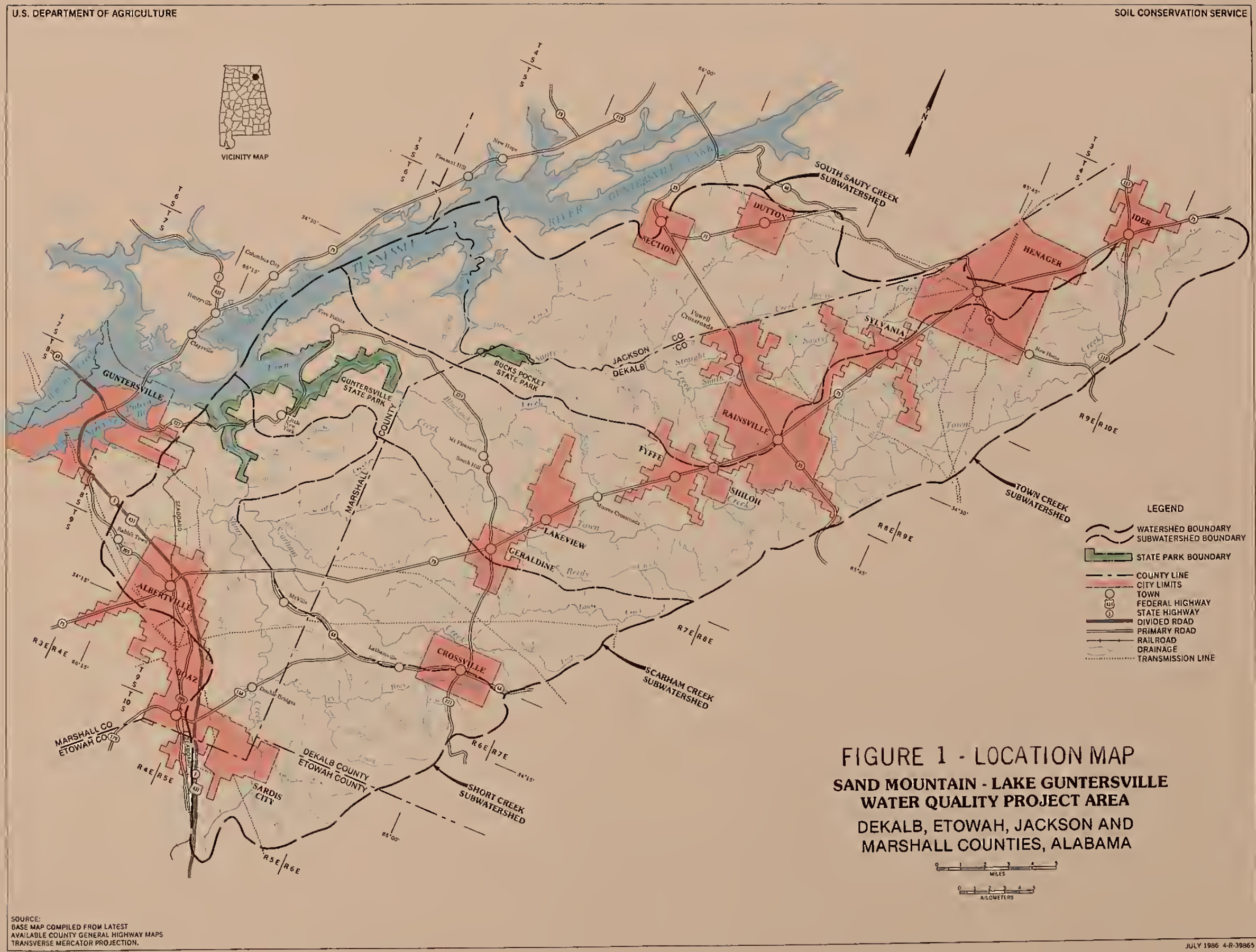

FIGURE 1 - LOCATION MAP

SAND MOUNTAIN - LAKE GUNTERSVILLE WATER QUALITY PROJECT AREA

DEKALB, ETOWAH, JACKSON AND MARSHALL COUNTIES, ALABAMA

SOURCE:
BASE MAP COMPILED FROM LATEST AVAILABLE COUNTY GENERAL HIGHWAY MAPS
TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

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WATER QUALITY PROBLEMS

GENERAL

Water quality problems are affecting Lake Guntersville, the streams of the watershed, and the area's ground water. Problems include high nutrient concentrations, bacterial pollution, and sediment. Other pollutants include dead animals and household garbage, polluted runoff from urban areas, and contamination from wastes disposed in abandoned wells.

Nutrients.

The Tennessee Valley Authority reports that 10 percent of the nutrient load entering Lake Guntersville is from Town Creek, the largest stream in the project area. All other watersheds draining directly into the lake contribute 10 percent of the load, and 80 percent enters through the Tennessee River. Since Town Creek Watershed contributes about one-tenth of 1 percent (0.1%) of the total inflow to the lake, it is apparent that this watershed is delivering a disproportionally high share of the nutrient load.

Studies by the U. S. Geological Survey (USGS) on Town Creek reveal that more than 10 tons of nitrogen (N) per day are discharged from Town Creek during high flows. The USGS work indicates that the greatest amounts of N are carried during the early spring. The lowest amounts move in late summer when rainfall is low and runoff from the land is less. No long-term stream data is available on phosphorus (P) concentrations in Town Creek.

While nutrients are essential to the development of a good aquatic environment, an excess of nutrients creates problems. High concentrations of nitrogen and phosphorus create algae blooms and stimulate abundant growths of other aquatic plants. Lake Guntersville is now experiencing serious problems with nuisance growths of algae and other plants. Such accelerated vegetative growth impairs boating, swimming, and fishing, and often is unsightly. Where the water is used for public water supply, the costs of treatment increase as additional chemicals are used to eliminate taste and odor problems and more frequent backwashing of filters is required. In addition, when extensive growths of algae are killed by sudden changes in temperature or light intensity, an increase in decaying organic load results in severe dissolved oxygen depletion; thus, higher forms of aquatic life become stressed.

The enrichment of streams in the watershed is evident by observing the mats of algae on the stream bottoms. Long-term stream data on Town Creek reflects unusually high concentrations of dissolved oxygen, including many instances of supersaturation. This is evidence of extensive algae growths in the stream. Water samples collected early in the morning reflect depressed oxygen levels. This, again, suggests the presence of extensive growths of algae.

Nutrients can also have an adverse effect on ground water. High concentrations of nitrate in a water supply can be dangerous to infants. Although data is not available on the nitrate levels in ground water within the watershed, conditions exist which create a high potential for nitrate contamination. These conditions are discussed further under SOURCES.

Bacteria.

Bacteria are common in our environment. Certain bacteria are pathogenic (disease causing) and represent a threat to public health. Other bacteria such as the fecal coliforms are often used as indicators of fecal contamination. TVA has found that concentrations of fecal coliform bacteria (those common to the intestinal tracts of warm blooded animals) are frequently high downstream of the Sand Mountain-Lake Guntersville Watershed. This suggests that wastes from either humans or farm animals, or both, are entering the lake. In certain locations and at certain times of the year, the waters of the lake are unfit for water-contact sports such as swimming and water skiing.

Bacterial pollution of ground water is a growing problem in the watershed. County health office records indicate that approximately 75 percent of all wells tested in the watershed are polluted by fecal coliform bacteria. This contrasts with approximately 25 percent polluted about 10 years ago.

Sediment.

A damaging sediment load is entering Lake Guntersville from the project area. This is confirmed by suspended sediment samples collected in the lake, by long-term measurements of sediment buildup in the embayments of the lake below selected streams, by in-stream measurements conducted by the U. S. Geological Survey (USGS), and by Soil Conservation Service calculations of sediment load based on erosion occurring in the watershed. The total sediment load (suspended load plus bedload) of the tributary streams is estimated to be 554,000 tons per year (Table 1). Since most of the tributary streams have narrow, v-shaped valleys

with little flood plain development, the majority of the sediment in the streams is delivered to the lake. When sediment in the streams enters the quiet waters of the lake, it settles out. Over many years, the embayments gradually fill. As more shallow-water areas are created, more aquatic vegetation appears. The shallow water and increased vegetation makes some areas unfit for recreational activities.

Table 1.
Annual Gross Erosion Rates, Sediment Loads, and Average Sediment Concentrations of the Primary Streams in the Sand Mountain-Lake Guntersville Watershed

Watershed Streams	Gross Erosion	Sediment			Average Annual Suspended Sediment Concentration
		Bedload	Suspended Load	Total Volume	
	(1000 tons/yr.)				(ppm)
Short Creek	451	51	75	126	322
Scarham Creek	304	38	56	94	357
Town Creek	771	71	106	177	273
South Sauty Creek	605	63	94	157	308
Total	2131	223	331	554	

Sediment from cropland causes secondary problems. Phosphorus is strongly attracted to soil particles. Cropland soils not well protected from erosion add not only to the sediment load but also to the nutrient load of the streams and the lake. The sediments in the lake contain high concentrations of phosphorus which enhances aquatic plant growth, and may also contain pesticides and other elements that can be harmful to aquatic organisms.

USES IMPACTED

Most of the major streams and water bodies of the state are classified by the Alabama Department of Environmental Management (ADEM) for specific uses. The use classifications designated by the state are as follows:

- Public Water Supply (PWS)
- Swimming and Other Whole-Body Water-Contact Sports (S)
- Fish and Wildlife (F&W)
- Shellfish Harvesting (SH)
- Agricultural and Industrial Water Supply (A&I)
- Industrial Operations (IO)
- Navigation (N)

Associated with each use classification is a set of water quality criteria. These criteria include such items as the allowable concentrations of fecal coliform bacteria, minimum dissolved oxygen levels, and other parameters.

The only stream in the watershed officially classified is Town Creek (F&W). All other streams and tributaries without designated uses are automatically classified as F&W. Lake Guntersville is classified for PWS, S, and F&W.

Potential impacts related to the individual uses identified in the project area are discussed in detail below.

Swimming and Other Whole-Body Water-Contact Sports (S).

Swimming and water skiing are the main whole-body types of water-contact sports occurring in the watershed. Although "swimming holes" exist on some streams, the bulk of the water-contact recreation occurs in Lake Guntersville.

The combination of increasing animal and human wastes, sediment, and other pollutants will lower the water quality of Lake Guntersville to the point that engaging in water-contact sports would be dangerous. Animal and human wastes create high levels of nutrients and bacteria that can induce health problems. These problems are more pronounced during extended dry conditions when the assimilative capacity of the streams are diminished.

High nutrient levels contribute to the growth and spread of aquatic plants such as milfoil and hydrilla. These plants create problems not only for swimmers and water skiers but also for other uses such as boating and fishing. Presently there are at least 15,000 acres of Lake Guntersville infested by undesirable aquatic plants. The full recreational use of this water is significantly impaired.

Sediment delivery to Lake Guntersville from the watershed is estimated to be in excess of 550,000 tons annually. This is reducing the lake capacity about 250 acre-feet each year. If this deposition continues, the embayments will become shallower, causing additional plant growth and further restricting recreational use.

Public Water Supply (PWS)

Waters for public use are drawn from several points in Lake Guntersville near stream outlets from the watershed. The water for Guntersville State Park is drawn from a point near the mouth of Town Creek, identified as one of the most polluted streams discharging into the lake.

Water from surface impoundments must be properly filtered and chlorinated before being delivered to users. When bacterial populations in the raw water are high, additional disinfection is needed. Waters containing high concentrations of suspended sediment and algae require more frequent backwashing of filters. Thus, the many non-point source pollutants in the watershed (bacteria, sediment, and nutrients) add to the cost of treating water for public consumption.

Ground Water Supplies

Wells and springs used for private consumption can be impaired by bacteria entering through the soil profile or through solution channels. Bacterial pollution of wells is a significant problem in this watershed and represents a severe public health hazard.

Nitrogen compounds in ground water can also be a problem. A disease called methemoglobinemia can occur in infants if waters contain high concentrations of nitrate. Wells in the watershed have not been routinely tested for nitrate. However, the amount of livestock and poultry waste generated and spread on a very limited acreage, the intensive application of commercial fertilizers, and the high concentration of septic tank systems create a potential for nitrate contamination of ground water.

Fish and Wildlife (F&W)

Very little information is available on the quality of fish and other aquatic life in the streams of the project area. Fish kills have occurred in the water-

shed which have been attributed to agricultural activities (discharges of animal waste and runoff waters containing pesticides). Visual observations indicate that the aquatic habitat is poor in many streams and tributaries.

Both sport and commercial fisheries in the lake are considered good at present. However, the increasing acreages of shallow water and the attendant increase in aquatic plants may soon alter this situation. A reduction in sediment and nutrient loads is needed to stop this trend.

Some of the water uses impacted by sediment and improper waste disposal are summarized in Table 2. The lack of information about the overall biological condition of the streams in the watershed and in Lake Guntersville indicates a need for additional studies. The absence of data concerning the presence of heavy metals and other toxic substances is recognized. These areas will be addressed in subsequent investigations.

SOURCES

Pollutants in streams of the watershed and in that portion of Lake Guntersville influenced by the discharge from those streams are originating from both agricultural and non-agricultural non-point sources. The main sources of pollution of the lake and streams include animal waste, leachate, and surface discharges from domestic septic tank systems, and sediment from eroding cropland. Other sources of pollution of surface waters include discharges of human wastes from pleasure boats on Lake Guntersville; garbage and debris dumped into creeks or along stream banks; runoff from urban areas, construction sites, and abandoned mines; and dead animals deposited in the streams. Data currently available does not allow a precise determination of the proportion of pollution coming from each source.

Table 2
Potential Water Use Impacts From Improper Waste Disposal and Sediment in the Sand Mountain-Lake Guntersville Watershed

Water Use Classification	Impairment or Contaminant	Potential Impact
Swimming and other whole-body water-contact recreation (S)	a. Fecal coliform count exceeding 200 f.c./100 ml.	a. Closing of Lake Guntersville to body-contact recreation.
	b. Pathogenic bacteria	b. Diseases in swimmers and waterskiers.
	c. Excess nutrients causing excessive growths of algae and other aquatic vegetation.	c. Visual impacts; inability of swimmers to use waters and small boats to safely navigate; taste and odor problems associated with algae growths.
	d. Sediment	d. Visual impacts; safety hazards for swimming, skiing, and boating due to shallow water.
Public Water Supply (PWS) Includes non-chlorinated wells, springs, and other sources of private, potable water	a. Fecal coliform count exceeding 2000 f.c./100 ml. at intake to system.	a. Closing of public water supplies, or additional treatment.
	b. Inability of small water treatment systems to eliminate excess bacteria.	b. Sickness in users of water supply; closing of water supplies.
	c. Pollution of non-chlorinated wells, springs, and other private drinking water sources.	c. Sickness in users of wells; taste and odor problems and visible impurities.

Table 2 - continued

Water Use Classification	Impairment or Contaminant	Potential Impact
	d. Excess nutrients	d. Growths of algae on sand filters requiring frequent maintenance; methemoglobinemia...a disease of infants due to high NO_3 levels; taste and odor problems.
	e. Sediment	e. Increased costs of filtration at water treatment plants.
Fish and Wildlife (F&W)	a. Organic matter lowering dissolved oxygen.	a. Death of fish and other aquatic organisms; lowering of species diversity.
	b. High concentrations of nutrients causing excessive growths of algae and other aquatic organisms.	b. Large diurnal shifts in dissolved oxygen with attendant stress on aquatic communities; die-off of algae resulting in loss of dissolved oxygen.
	c. High concentration of unionized ammonia.	c. Fish kills; outmigration of desirable fish.
	d. Sediment	d. Covering of spawning beds; loss of filter feeders, irritation of fish gills, and general disruption of food web.

Point discharges of municipal, industrial, and semi-public and private wastes directly into streams do not appear to be a major source of pollution. These discharges are monitored by the state and generally meet the standards adopted to protect the receiving streams. However, proper operation and maintenance of these systems, particularly the package treatment and lagoon types, is critical. Otherwise, untreated "raw" sewage is discharged into receiving streams.

The main sources of pollution are discussed in detail below:

Agricultural Wastes.

Improperly operated livestock and poultry systems are polluting both surface waters and ground water. During the past three years the Alabama Department of Environmental Management (ADEM) has had more complaints on water quality problems from livestock and poultry operations in DeKalb County than in any other county in the state. The majority of these complaints occurred in the Sand Mountain-Lake Guntersville watershed.

The concentrations of hogs and poultry in this watershed are among the highest in the state. DeKalb County is the No. 1 hog producing county in Alabama. DeKalb and Marshall Counties are No. 2 and 3, respectively, in egg production statewide and are No. 3 and 2, respectively, in broiler production. Within the project area, about 15,000 hogs and 9 million chickens of all types are on hand at any time. These animals produce about 290,000 tons of wastes per year, enough to cover 100 acres to a depth of about 2.2 feet. This volume of waste contains about 3,500 tons of N, 1,800 tons of P_2O_5, and 1,900 tons of K_2O.

Complicating the problem of sheer numbers of animals is their density in relation to the land available for spreading wastes. Most livestock and poultry producers confine large numbers of animals or birds to improve efficiency of production; however, many of these producers do not own sufficient land to fully utilize the nutrients available. Thus, wastes are often spread on small areas at high rates which preclude full utilization of the nutrients by the receiving crop. These high application rates increase the potential for polluted runoff. The high nutrient levels in surface waters during the spring are attributed, in part, to improper land application of wastes. Applications at high rates also increase the chance of nutrients and bacteria leaching into the ground water.

In addition to land application, problems result from no application or failure to contain wastes on the producer's land. (These situations account for most of the complaints to ADEM). Typical of this type situation are dairy, beef, and small-scale hog operations in which the animals are "on pasture"--this being an area devoid of vegetation and often located in spring heads or adjacent to creeks which serve as a water supply. Others in this category are producers who have lagoons or waste storage ponds but simply fail to apply the wastewater to the land when the lagoon or pond gets full. A recent field review of the area reveals that about 60 percent of the producers with treatment systems allow them to overflow at some time during the year. Since the effluent is highly enriched, its release to a nearby stream or to a farm pond is undesirable.

In addition to fecal materials generated by livestock and poultry, other agricultural wastes are produced in the watershed. One of these is dead animals. The normal mortality of poultry in the watershed is estimated to be 2.1 million

birds per year. Dead birds should be delivered to rendering plants, incinerated, or placed in pits. However, many birds are deposited on remote areas of the owner's property with high potential for pollution of surface waters. Some are dumped directly into streams.

In recent years the discovery of high levels of mercury, arsenic, PCB's, and dioxons in other TVA lakes on the Tennessee River and in Weiss Lake on the Coosa River have necessitated their being closed to certain types of fishing. Pollution by these dangerous compounds has, however, been greatly reduced. Many of the ingredients in pesticides, herbicides, and fungicides commonly used in crop production can be transported with sediment or in surface runoff. Additional sampling is needed to determine if unsafe levels of these compounds are present in the project area.

Domestic Wastewater.

More than 10,000 septic tank systems are used to treat domestic wastewaters in the Sand Mountain-Lake Guntersville Watershed. The potential for pollution from these systems is high because 90 to 95 percent of the soils in which they are located are rated as "severely limited" for this type use. The soils are shallow (often less than 4 feet to bedrock) and have moderate to steep slopes. When soils become saturated, wastes migrate upward and across the land in surface runoff. Normally, the wastewater percolates to bedrock and then migrates down-slope along the rock to a streambank, roadbank, or other area where the soil-rock interface is exposed. Many private residences with septic tank systems are located adjacent to Lake Guntersville and health officials concede that a high percentage of lakeside septic systems are likely to be discharging into the lake.

Leachate from field lines also poses a threat to ground water. The high incidents of contaminated wells in the watershed may be attributed to leachate from overloaded field lines. The extent to which overloaded field lines contribute to the surface water or ground water problems has not been firmly established. Further monitoring throughout the watershed is needed to ascertain the relative significance of agricultural sources or domestic wastewaters as pollutants.

Sediment.

Sediment is the greatest single pollutant by volume in U. S. surface waters. Sediment from soil erosion has reduced stream and reservoir capacities, disrupted biological systems, degraded public water supplies, and translocated nutrients and possibly pesticides to the streams of the watershed and to Lake Guntersville.

Erosion is difficult to control on the shallow soils and sloping land in the project area. Gross erosion in the project area averages 5.5 tons per acre per year which exceeds the allowable tolerance of all the soils. Land uses with the highest erosion rates include cropland and some minor uses such as farmsteads, strip mines, construction sites, roads, and highways.

Cropland erosion rates average 10.2 tons per acre per year, which is about three times the acceptable rate for sustained production and protection of the soil resource base. While this is an average erosion rate, some cropland fields have soil losses up to 40 tons per acre. An example is the high erosion occurring on about 6,500 acres of Irish potatoes.

The project area contains some surface mining activity. Current regulations require that all new mine starts have preapproved plans for controlling erosion, runoff, and reclamation of sites. These controls ensure that erosion from these activities is minimized. Investigations indicate that abandoned mines in the project area need only minimal treatment. Most areas have either been treated or do not have significant problems. Some instances of excess erosion are occurring in gravel and chert pits and on construction sites within the project area.

TRENDS

Water quality problems are expected to increase in the future, especially nutrient and bacterial pollutants created by the increases in the human population (projected at 2% per year) and the poultry populations (projected at 10% per year for broilers and 5% for laying hens). The wastes generated from these sources will likely continue to be treated or utilized the same way in the next few years as they are now. More agricultural wastes will be applied on limited acres, and more septic tank systems will be installed in areas where soils have severe limitations for such use. Complaints of water and air pollution will increase as the rural population becomes more sensitive to problems resulting from increased populations of livestock and poultry.

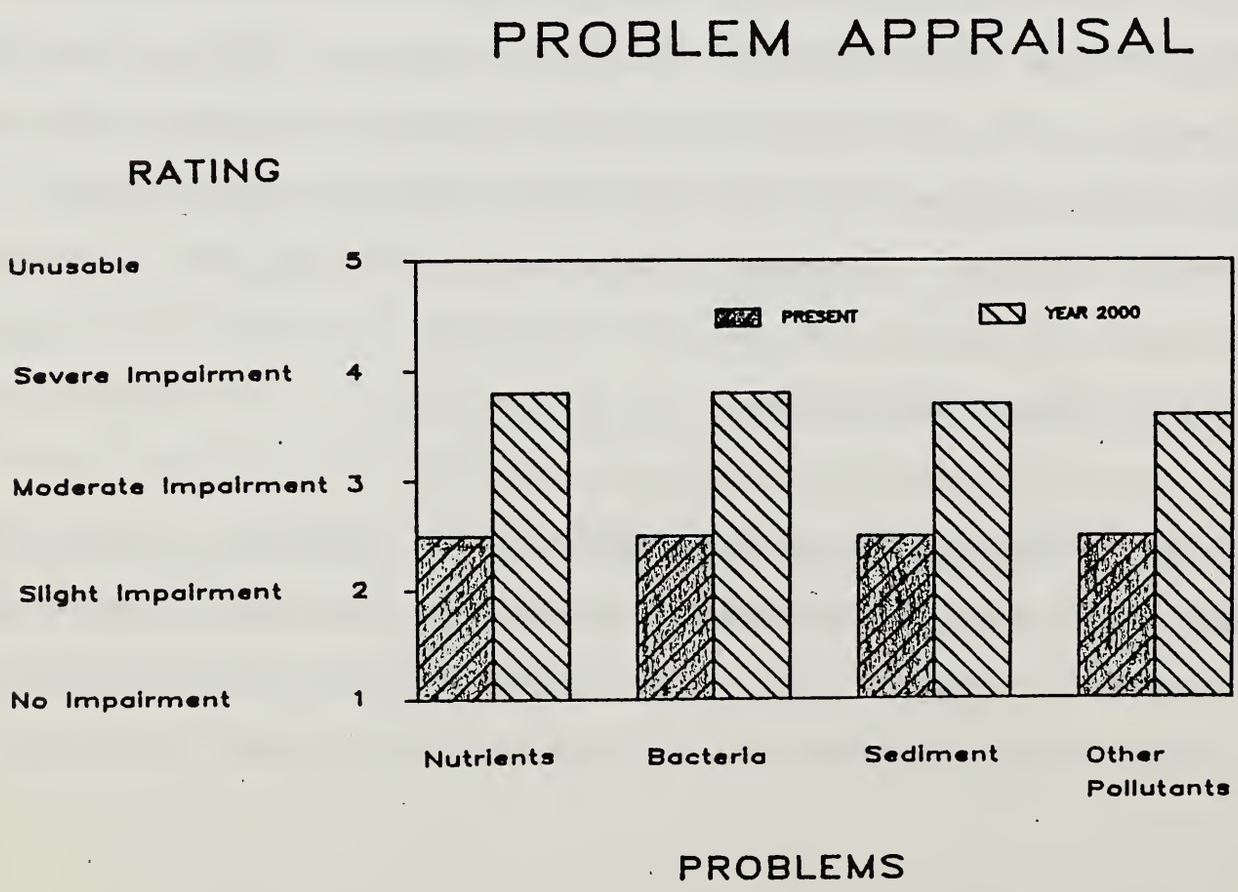
Existing conservation programs may bring about a slight reduction in the amount of sediment entering the lake primarily through conversion of some of the steeper eroding cropland to permanent cover. Significant reductions cannot be expected, however, without major initiatives to treat the remaining cropland for erosion.

PROBLEM APPRAISAL

An assessment of the water quality problems of the area was made by participants in the work group developing the plan. Two time frames were considered: the present, and year 2000. Each problem was rated on a scale of 1 (fully usable, with no known impairment) to 5 (unusable). Composite values for each of the major problems are displayed in Figure 2.

Information in Supplement 1 offers a more complete assessment of the water quality problems and associated impacts identified in this plan.

Figure 2. Assessment of Water Quality Problems,
Sand Mountain-Lake Guntersville Watershed



MONITORING AND EVALUATION

Surface Waters

Several methods are being used to identify those streams and subwatersheds having water quality problems and those with the greatest potential for pollution of Lake Guntersville. Some of these methods include a review of historical water quality records, a current sampling program throughout the watershed, and aerial photography.

Historical Data

Historical records include data from a USGS (later, TVA) sampling station on Town Creek at State Highway 75. The data were stored on EPA's STORET computer system and include data for the past two decades. Some of the water quality problems identified through the STORET data have been discussed in the section entitled WATER QUALITY PROBLEMS. However, it is noted that this station is located on a major stream near the lower end of the watershed and, therefore, cannot serve to pinpoint the location of non-point sources or to isolate subwatersheds upstream where major problems may be occurring. It does reveal that excessive nutrients and sediment are passing this particular point on the stream.

Current and Future Sampling

In order to better identify specific streams and subwatersheds contributing to the pollution of Lake Guntersville, nine sampling stations were established

throughout the watershed early in 1986. Water samples were collected at weekly intervals for a six-week period during May and June 1986. The samples were evaluated for nutrients, bacteria, and suspended sediment. The weather prior to and throughout the sampling period was exceptionally dry, with no runoff-producing storms occurring. As a result of the unusual weather, the water quality data do not reflect the influence of runoff from areas that would have an impact on the streams and lake. The concentrations of total phosphorus (TP) and total suspended solids (TSS) were low, due to the drought conditions and low flow. The total inorganic nitrogen concentrations at all stations regularly exceed the concentrations that, when accompanied by suitable phosphorus concentrations, would cause algae blooms in a lake. In some cases, the nitrogen concentrations were more than three times the acceptable level. During more normal runoff events, the nitrogen concentrations would exceed these existing high levels.

The fecal coliform (FC) and fecal streptococcus (FS) bacteria concentrations were high at some stations and moderate to low at others. However, these concentrations do not reflect the influence of storm runoff.

The FC/FS ratios are sometimes used to help distinguish between human and animal sources. Even though the FC/FS ratios at all locations suggest that farm animals would be the primary source of bacteria, the ratio method can yield questionable results when the concentrations are less than 1,000 and the source is at some distance from the sampling station. Further study is needed during various weather conditions to confirm the source of bacterial pollution.

The location of sampling stations and the sampling data described above are included in Supplement 1.

A more detailed water quality monitoring program will be initiated in FY-1987 to better characterize the "health" of streams in the watershed and to quantify the pollution load being delivered to the lake. Nutrients and bacteria will continue to be monitored. Fish population and benthic communities will also be evaluated in selected streams.

The sampling program will establish baseline conditions in selected streams before any improvements occur on the land. Monitoring will continue beyond FY-1987 to add to the baseline data and then to evaluate changes in water quality as best management practices (BMP's) are applied on the land. Water quality conditions subsequent to installing BMP's will be compared with baseline data to assess the degree of improvement.

Aerial Photography

The Tennessee Valley Authority is studying recent aerial photos of the entire watershed. During FY-1987 they will interpret the photos by identifying all livestock and poultry facilities, land uses, and estimates of erosion rates, drainage patterns, etc. The aerial photos will be used in conjunction with water quality data to identify not only the location of problem areas, but also the nature of the pollution sources (i.e., livestock, fertilizer runoff, septic tanks, etc.)

Ground Water

County health officials have recognized a growing problem of ground water pollution based on their analyses of well water samples collected by homeowners. They

estimate that 75 percent of domestic well samples delivered for analyses are contaminated by bacteria.

Pollution of ground water may be from septic tank field lines or from livestock and poultry operations. Comments at the public meetings held early in the plan development stage indicated that abandoned wells are a source of ground water pollution since some are being used as receptacals for various types of refuse. Surface runoff directly enters some of these wells due to lack of proper casing and covers. Leachate from sanitary land fills, both active and closed, also contribute to ground water problems.

The Geological Survey of Alabama conducted a survey of wells in Jackson County in FY-1986. The sampling did not include bacterial analysis because the potential problem of contamination by humans or farm animals was not recognized at the onset of sampling. However, nitrates were evaluated, which may be helpful in relating man's activities to possible ground water pollution. The results of this study should be available in early 1987.

In FY-1987 USGS will evaluate approximately 100 wells and springs in DeKalb County. Both bacteria and nitrate analyses will be conducted. This sampling program should help identify the sources of ground water pollution.

POLLUTION ABATEMENT PRACTICES

Precise estimates of the proportions of pollutants originating from agriculture and non-agricultural sources are not yet available. Significant progress must be made in reducing all major sources--animal and domestic wastes; erosion; and the disposal of dead animals and other refuse--before measurable improvements in water quality will be realized. The general types of practices needed and their estimated installation costs for cleanup of major pollution sources are presented below. Estimates do not include technical assistance needed for planning and application, nor are estimates available for treatment of rural domestic waste.

AGRICULTURAL WASTE MANAGEMENT

Abatement of pollution from livestock and poultry wastes will cost an estimated $3.6 million. This is the direct cost of new or up-graded waste management facilities needed on existing livestock and poultry operations. They include the collection, treatment, and disposal of animal and poultry manure at the production site; the transporting and application of waste on land; the disposal of dead birds, animals, and other associated waste materials; and the exclusion of animals from springs and streams.

A wide range of facilities or practices will be needed depending on the type and size of operation and the management scheme used by the operator. Some typical systems are listed as follows:

-Anaerobic lagoon for long-term storage and partial treatment--liquid and solid residue disposal by land spreading.

-Holding tank for short-term storage--land disposal by hauling and spreading or by irrigation.

-Dry stacking storage facility--land disposal by hauling and spreading.

-Dry storage and composting--compost used as livestock feed or for land application.

-Exclusion from streams--Fencing, filter strips, alternative water sources, and similar practices.

-Dead-bird disposal pits.

The estimated number and cost of systems needed by animal type are shown in Table 3. Agricultural agencies and universities are developing technology which will lead to new economical methods of waste disposal. As these methods become available, they will be recommended where applicable in the project area.

Table 3.
Livestock and Poultry Waste Management Systems Needed
in the Sand Mountain-Lake Guntersville Watershed

System	Number	Cost
Swine		
New Systems	185	$670,000
Up-graded Systems	12	140,000
Poultry		
New Systems	12	290,000
Up-graded Systems	39	510,000
Dead Bird Pits	305	460,000
Dairy Cows		
Up-graded Systems	5	70,000
Livestock Exclusion (pastured animals)	7	30,000
Beef Cattle		
Livestock Exclusion (pastured animals	200	1,430,000
TOTAL COST		$3,600,000

DOMESTIC WASTE MANAGEMENT

The combination of a high density of septic tanks and thin soils on Sand Mountain creates a situation very conducive to ground and surface water pollution by bacteria and nutrients from domestic waste. Data collection and monitoring during the early implementation phase of clean-up will better define domestic sewage problems.

It is anticipated that long-range needs will include alternative methods of disposal. Measures may include up-grading some individual systems, collection and treatment in "cluster" or small group systems, and conventional collection and wastewater treatment systems to serve more densely-populated areas. Costs cannot be estimated until feasibility and preliminary planning studies are conducted. Strong local government leadership will be essential to the success of domestic waste treatment efforts.

Numerous open-top abandoned wells located throughout the project area should be filled or capped to prevent their use as waste receptacles. Local programs to locate and cap wells using county labor and equipment can be carried out with minimum costs.

SOIL EROSION

The majority of the sediment in the streams and embayments in the project area is coming from excessive erosion on cropland. Treatment of cropland erosion is grouped into two levels; severe erosion where the annual rate exceeds twice the tolerance level ($>2T$); and moderate erosion where the annual rate is between the

tolerance level and twice the tolerance rate (T-2T). There are 64,500 acres of cropland in the severe category and conservation treatment will average $150 per acre or $9,675,000 total. Some 25,000 acres of cropland have moderate erosion and treatment will average $75 per acre or $1,882,500. The total cost to treat excessive erosion on cropland is $11,557,500. A significant portion of the severely eroding cropland may be converted to permanent cover through the USDA Conservation Reserve Program.

Other minor areas with severe erosion include rural roadbanks, construction sites, and unreclaimed mine sites. Further investigations are needed to determine the extent and costs to treat erosion on these areas.

TECHNOLOGY DEVELOPMENT AND TRANSFER

Research to provide more practical methods are being undertaken by several of the agencies involved in the Sand Mountain-Lake Guntersville Water Quality Project. Leaders in technology development are tha AAES, TVA, and EPA. ACES, SCS, TVA, and other technical or education agencies will integrate research findings and new technologies into recommendations for waste clean-up.

Adequate information on the management of waste treatment facilities is essential to successful pollution control. Demonstrations, seminars, and one-on-one contact will be utilized by the cooperating agencies to assist farmers, businessmen, and homeowners in understanding and adopting both existing and new practices for pollution abatement.

RECOMMENDATIONS--A STRATEGY FOR CLEAN-UP

The problems plaguing the waters of Sand Mountain and Lake Guntersville did not develop overnight and neither can they be corrected in a short time. Clean-up will require an integrated strategy for action including all levels from individual citizens to federal and state government. Success will require strong leadership and cooperation at the local governmental level. Financial and technical assistance for applying many needed solutions are available through state and federal programs. The job can only be done, however, through an awareness of the importance of protecting the area's waters on the part of local citizens and a willingness by both citizens and local government to contribute to the effort.

The apparent interrelated nature of known water quality problems makes it impossible to single out one pollution source which should receive first priority for clean-up. The recommendations included herein must be considered as a total strategy rather than individually. Progress will require a coordinated attack on all sources of pollution.

Since several agricultural programs are available to assist farmers in their clean-up efforts while actions to solve domestic sewage problems are in their infancy, progress in agriculture may be more immediate than in other areas. Currently, it does not appear reasonable to initiate new agricultural activities such as the Small Watershed Program (PL 83-566) unless there is an indication that local governments will begin moving toward resolving domestic waste and other problems. Clean-up of agricultural pollution without action on other fronts would probably not have a significant effect on water quality. Continued

data collection and water quality monitoring during early stages of implementation will provide better direction for concentrating on the most critical problems or locations.

Recommendations for actions are in five primary areas:

I. Water Quality Monitoring and Evaluation
II. Information and Education
III. Research and Demonstration
IV. Agricultural Pollution Abatement
V. Urban and Rural Domestic Waste Management and Other Measures

These five broad areas for action can be further divided into time frames where action can occur. Early implementation or immediate action can take place in Areas I, II, and III. Item IV, Agricultural Pollution Abatement, can take place in the immediate and mid-range time frames. Agricultural pollution can be practically eliminated in 10 to 15 years or before the Year 2000. Item V, which deals with non-agricultural pollution includes activities spanning the period from early action to long-range implementation. Low cost non-agricultural abatement measures such as information and regulatory activities can begin immediately.

The lead time required to develop public understanding and support, make feasibility studies, do planning, complete design, and secure funding for major public waste treatment facilities will be extensive. Short-range improvement in domestic waste treatment will depend on the feasibility of improved individual or small group facilities. The Year 2000 may well be a reasonable goal for beginning construction of major public waste treatment facilities.

Specific recommendations for action are shown in Table 4. Effective implementation will require strong leadership and full cooperation by local governments. TARCOG, the state's regional planning agency, can assist in coordinating local government activities. Agricultural pollution abatement efforts can be coordinated at the local level by the Sand Mountain-Guntersville Lake Water Quality Committee.

The Alabama 208 Agricultural Task Force can, if requested, provide overall coordination of further planning efforts. Each participating agency will take the lead in coordinating on-going programs and needed actions within its area of responsibility.

The Committee has requested the Steering Committee of Operation SOIL to provide support in solving the area's water quality problems. Operation SOIL, an innovative ad-hoc effort to coordinate agricultural programs in the Tennessee Valley (including the Sand Mountain area), will provide added emphasis to clean-up efforts, particularly in the areas of information, education, and demonstrations. It is anticipated that the planned demonstration farms will be carried out through Operation SOIL's Resource Management Demonstration Farm concept.

Overall planning for clean-up of the Sand Mountain-Lake Guntersville watershed must be an open-ended process. Availability of further information from water quality monitoring, new technology, changes in available programs, economic trends, or public perception of the problem will likely require that the overall plan be updated. Strong local leadership and full cooperation by all involved agencies can ensure progress in reversing the deterioration of the area's waters and the maintenance or improvement of the quality of life in the region.

Table 4. Recommendations

Item I. Water Quality Monitoring and Evaluation

Actions	Participating Agencies	Schedule and Cost [1/] - (1986 Dollars) FY-87	FY-88	FY-89	FY-90	FY 91-95	FY 96-2000
A. Photo mapping and interpretation	TVA	→					
B. Select critical watersheds	SCS, TVA	→					
C. Select demonstration watershed	SCS, TVA, EPA, ACES, SWCD's	→					
D. Monitor water quality	TVA, SCS, ADEM, DCNR	48,000	66,000	36,000	36,000	100,000	50,000 →
E. Estimate pollution loads to streams	SCS, TVA, SWCD's	→					
F. Evaluate impacts of septic tank systems on surface and ground water.	GSA, SCS, TVA, ADPH	→					
Subtotal		48,000	66,000	36,000	36,000	100,000	50,000

1/ Costs, where estimated, reflect accelerated funding and do not include assistance provided by participating agencies through going programs. Fiscal '87 estimates are based on preliminary agency budgets. Funding for later years is based on staff planning estimates.

Table 4 (cont'd)

Item II. Information and Education

Actions and Costs[2/]	Participating Agencies	Schedule FY-87	FY-88	FY-89	FY-90	FY 91-95	FY 96-2000
A. Inform local government leadership of area's water quality problems and opportunities for solution. Develop local government leadership in seeking solutions.	SWCD, SCS, TVA, ADPH, ADEM, TARCOG	→	→	→			
B. Conduct information campaign and solicit support of business, agricultural, and civic leaders.	SWCD, SCS, TVA, ADPH, ADEM, ACES	→	→	→			
C. Publicize water quality problems and develop understanding and support by general public.	SWCD, SCS, TVA, ADPH, ADEM, ACES	→	→	→			
D. Educate poultry industry and farm leadership on water quality problems associated with continued expansion of production.	ADEM, TVA, ACES, SCS		→	→	→		
E. Accelerate information to farmers to assist them in operating and maintaining existing animal waste facilities and in adopting new economical ways of managing waste.	ACES, SWCD, SCS, TVA		→	→	→		
F. Inform builders and homeowners of problems with septic tanks and provide criteria for design and maintenance in high risk areas.	ADPH, SWCD, SCS, ACES, TVA, ADEM	→	→	→	→		

2/ No cost estimates available.

Table 4 (cont'd)

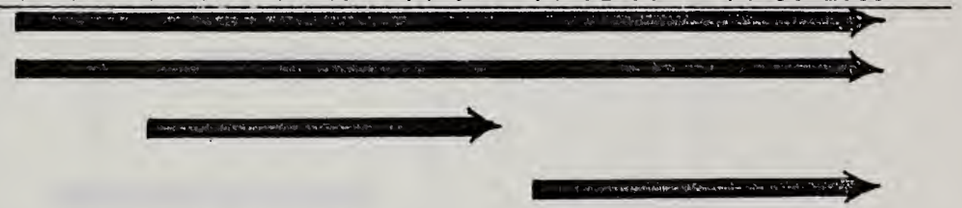
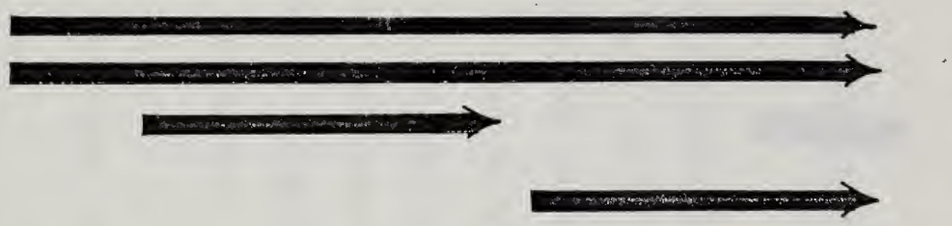
Item III. Research and Demonstration

Actions	Participating Agencies	Schedule and Costs[1/] - (1986 Dollars) FY-87	FY-88	FY-89	FY-90	FY 91-95	FY 96-2000
A. Establish Water Quality Research Initiatives at Sand Mountain Experiment Station							
1. Disposal of pesticide rinsate and containers	AAES, TVA				→	→	→
2. Land application of animal waste	AAES, TVA				→	→	→
3. Utilization of chicken litter for animal feed	AAES, TVA				→	→	→
B. Establish Demonstration Farms							
1. Select farms and administer program	TVA, ACES, AAES, SWCD, SCS, ASCS	20,000	20,000	20,000	10,000		
2. Plan and install new and innovative technologies	TVA, EPA, SWCD, AAES, SCS, ASCS	20,000	50,000	30,000	20,000		
3. Demonstrate and encourage the implementation of new technologies	TVA, ACES, SWCD, SCS, ASCS		30,000	0	50,000	50,000	
4. Monitor water quality at edge of fields or in nearby streams	TVA, EPA, SCS, AAES	14,000	28,000	28,000	25,000		
Subtotal		54,000	128,000	78,000	115,000	50,000	

1/ Costs, where estimated, reflect accelerated funding and do not include assistance provided by participating agencies through going programs. Fiscal '87 estimates are based on preliminary agency budgets. Funding for later years is based on staff planning estimates.

Table 4 (cont'd)

Item IV. Agricultural Pollution Abatement

Actions and Costs[3/]	Participating Agencies	Schedule FY-87 FY-88 FY-89 FY-90 FY 91-95 FY 96-2000
A. Install 397 new animal waste management systems Cost - $2.4 million	State ARCP USDA-ASCS (Regular ACP) USDA-ASCS (Special ACP) USDA-SCS (Small Watershed)	
B. Upgrade 56 existing animal waste management systems Cost - $720,000	State ARCP USDA-ASCS (Regular ACP) USDA-ASCS (Special ACP) USDA-SCS (Small Watershed)	
C. Install 305 dead-bird pits Cost - $460,000	State ARCP USDA-ASCS (Special ACP) USDA-SCS (Small Watershed)	
D. Install erosion control measures on 89,500 acres of cropland Cost - $11.6 million	State ARCP USDA-ASCS (Regular ACP) USDA-ASCS (Special ACP) USDA-SCS (Small Watershed)	
Subtotal - $15.2 million		

3/ Costs are total direct outlays for installing measures and do not reflect cost-sharing between operators and financial assistance programs. The cost of technical assistance for planning and application is not included.

Table 4 (cont'd)

Item V. Urban and Rural Domestic Waste Management and Other Measures

Actions and Costs [2/]	Participating Agencies	Schedule FY-87	FY-88	FY-89	FY-90	FY 91-95	FY 96-2000
A. Sewage treatment needs and feasibility studies	City Govt., county commissions, TARCOG, ARC, & EPA		→	→	→		
B. Plan and design sewage collection and/or treatment systems	City govt., county commissions, TARCOG, ARC, & EPA				→	→	→
C. Install sewage treatment facilities	City govt., county commissions, TARCOG, ARC, & EPA						→
D. Review septic tank permitting activities and upgrade requirements to reduce pollution hazard from new installations	City Gov't., County Commissions, Local Health Depts.	→	→	→			
E. Improve rural garbage collection and compliance with anti-dumping and related laws	County commissions		→	→	→		
F. Locate and cap abandoned wells	County commissions, SWCD, city govt.	→	→	→			
G. Implement local sediment and runoff control regulations	City govt., county commissions, SWCD	→	→	→			

2/ No cost estimates available

PROJECT BENEFITS

Although the 400,000 acres in the project area is only a small part of the drainage area of Lake Guntersville, it contributes a disproportionately large pollution load. Clean-up of Town Creek and the other project area streams will eliminate about 10 percent of the total pollutant load to the lake. Noticeable improvements are expected in Lake Guntersville downstream from the watershed; however, the most significant improvements will be in the embayments of Town, South Sauty, and Short Creeks. Bacterial contamination and the threat of nitrogen pollution of the area's groundwaters should be greatly reduced.

Some of the expected benefits to the human and natural environment include:

- -Improved diversity of fish and other aquatic organisms in the streams and affected portions of the lake.
- -Reduction in rate of growth of aquatic weeds in Lake Guntersville, thereby slowing the decline in fishing, boating, and other recreational uses.
- -Reduction in sediment entering the lake. This will slow the encroachment of shallow, unusable areas in the embayments of watershed streams.
- -Reduction of objectionable odors and unsightly areas in area streams, Lake Guntersville, and in rural areas of Sand Mountain.
- -Protection of ground water quality for domestic supplies and other uses.

Economic benefits from clean-up will be substantial. Firm estimates of economic benefits are not yet available; however, significant benefits will accrue from:

- -Preservation and enhancement of the local water-based tourism industry.
- -Maintenance of the quality of both sport and commercial fisheries.

runoff control regulations

county commissions, SWCD

2/ No cost estimates available.

-Reduced treatment costs for municipal water.

-Enhanced real estate values along the shore of Lake Guntersville and on Sand Mountain as domestic waste problems are solved.

-Increased agricultural yields and reduced fertilizer costs from proper use of nutrients from animal waste.

-Improved soil productivity resulting from reduced cropland erosion.

When the actions outlined in the plan are accomplished, a positive step will be made toward preserving the quality of the environment and in bringing man's activities more in harmony with his environment.

ABBREVIATION OF AGENCY NAMES

AAES.	Alabama Agricultural Experiment Station
ACES.	Alabama Cooperation Extension Service
ADEM.	Alabama Department of Environmental Management
ADPH.	Alabama Department of Public Health
ARC.	Appalachian Regional Commission
ARCP.	Alabama Resources Conservation Program
ASCS.	USDA Agricultural Stabilization and Conservation Service
DCNR.	Alabama Department of Conservation and Natural Resources
EPA.	United States Environmental Protection Agency
GSA.	Geological Survey of Alabama
SCS.	USDA Soil Conservation Service
SWCD.	Soil and Water Conservation District
TARCOG.	Top of Alabama Regional Council of Governments
TVA.	Tennessee Valley Authority
USDA.	United States Department of Agriculture
USGS.	United States Geological Survey